

Claim Listing

1. (Original) A method for formation evaluation results from a multi-dimensional representation of nuclear magnetic resonance data, the method comprising the steps of:
 - Obtaining a set of NMR data for a fluid sample;
 - Computing from the set of NMR data a multi-dimensional distribution using a mathematical inversion independent of prior knowledge of fluid sample properties;
 - Displaying the multi-dimensional distribution as an at least two-axis graph;
 - Identifying at least one fluid instance on the graph representing a probable existence of a detected fluid; and
 - Computing a quantitative formation evaluation value for the at least one fluid instance based on the multi-dimensional distribution associated with the at least one fluid instance.
2. (Withdrawn) The method of claim 1, wherein the computing a quantitative formation evaluation value further comprises the step of:
 - Applying a model dependent inversion to calculate quantitative formation evaluation values of the fluid sample, the model dependent inversion being based on the at least one fluid instance.
3. (Withdrawn) The method of claim 1, wherein the computing a quantitative formation evaluation value further comprises the step of:
 - Integrating over a region of the graph associated with the at least one fluid instance to obtain a total amplitude.
4. (Withdrawn) The method of claim 1, wherein the computing a quantitative formation evaluation value further comprises the step of:
 - Eliminating from the graph fluid instances representing a probable existence of a detected fluid such that no more than two fluid instances are visible;
 - Computing a mean value across a region of the distribution associated with the at least one fluid instance;

Computing a quantitative formation evaluation value based on the computed mean value.

5. (Original) The method of claim 1, wherein the mathematical inversion is based on a maximum entropy process.
6. (Original) The method of claim 1, wherein the multi-dimensional distribution is displayed along a fluid diffusion axis and a T_2 relaxation axis.
7. (Original) The method of claim 5, wherein the graph includes an overlay with ideal diffusion and T_2 relaxation values.
8. (Withdrawn) The method of claim 1, wherein the steps of identifying, integrating and computing quantitative formation evaluation values is repeated for additional fluid instances.
9. (Withdrawn) A method for determining quantitative formation evaluation results from a multi-dimensional representation of nuclear magnetic resonance data, the method comprising the steps of:

Obtaining a set of NMR data for a fluid sample;

Computing from the set of NMR data a multi-dimensional distribution using a mathematical inversion independent of prior knowledge of fluid sample properties;

Displaying the multi-dimensional distribution as an at least two-axis graph;

Identifying at least one fluid instance on the graph representing a probable existence of a detected fluid; and

Applying a fluid response model to calculate quantitative formation evaluation values of the fluid sample, the fluid response model being based on the at least one fluid instance.

10. (Withdrawn) The method of claim 9, wherein the mathematical inversion is based on a maximum entropy process.
11. (Withdrawn) The method of claim 9, wherein the multi-dimensional distribution is displayed along a fluid diffusion axis and a T_2 relaxation axis.

12. (Withdrawn) The method of claim 11, wherein the graph includes an overlay with ideal diffusion and T_2 relaxation values.

13. (Withdrawn) The method of claim 11, wherein the identifying step further comprises the step of:

Determining a diffusion value associated with the at least one fluid instance; and

Determining a fluid type associated with the at least one fluid instance.

14. (Withdrawn) The method of claim 13, wherein the model is in part based on the diffusion value and the fluid type.

15. (Withdrawn) The method of claim 9, further comprising the step of identifying for additional fluid instances.

16. (Withdrawn) The method of claim 9, wherein the formation evaluation values are quantitative values associated with the fluid instance of at least one of fluid volume, saturation, viscosity, porosity, and permeability.

17. (Withdrawn) A method for determining quantitative formation evaluation results from a multi-dimensional representation of nuclear magnetic resonance data, the method comprising the steps of:

Obtaining a set of NMR data for a fluid sample;

Computing from the set of NMR data a multi-dimensional distribution using a mathematical inversion independent of prior knowledge of fluid sample properties;

Displaying the multi-dimensional distribution as an at least two-axis graph;

Identifying at least one fluid instance on the graph representing a probable existence of a detected fluid;

Integrating over a region of the graph associated with the at least one fluid instance to obtain a total amplitude; and

Computing quantitative formation evaluation values associated with the at least one fluid instance using the total amplitude.

18. (Withdrawn) The method of claim 17, wherein the mathematical inversion is based on a maximum entropy process.
19. (Withdrawn) The method of claim 17, wherein the multi-dimensional distribution is displayed along a fluid diffusion axis and a T_2 relaxation axis.
20. (Withdrawn) The method of claim 19, wherein the graph includes an overlay with ideal diffusion and T_2 relaxation values.
21. (Withdrawn) The method of claim 19, wherein the region is selected to encompass substantially all portions of the graph having a positive amplitude and associated with the fluid instance.
22. (Withdrawn) The method of claim 19, wherein the region is selected automatically using an edge detection algorithm.
23. (Withdrawn) The method of claim 19, further comprising the step of:
Determining a fluid type associated with the at least one fluid instance based on a combination of prior knowledge of the well and the proximity of the fluid instance in relation to ideal diffusion values.
24. (Withdrawn) The method of claim 17, wherein the steps of identifying, integrating and computing quantitative formation evaluation values is repeated for additional fluid instances.
25. (Withdrawn) The method of claim 17, wherein the formation evaluation values are quantitative values associated with the fluid instance of at least one of fluid volume, saturation, viscosity, porosity and permeability.
26. (Withdrawn) A method for determining quantitative formation evaluation results from a multi-dimensional representation of nuclear magnetic resonance data, the method comprising the steps of:
Obtaining a set of NMR data for a fluid sample;
Computing from the set of NMR data a multi-dimensional distribution using a mathematical inversion independent of prior knowledge of fluid sample properties;

Displaying the multi-dimensional distribution as an at least two-axis graph;

Identifying at least one fluid instance on the graph representing a probable existence of a detected fluid;

Computing a mean value across a region of the distribution associated with the at least one fluid instance; and

Computing a quantitative formation evaluation value based on the computed mean value.

27. (Withdrawn) The method of claim 26, further comprising the step of:

Eliminating from the graph fluid instances representing a probable existence of a detected fluid such that no more than two fluid instances are visible.

28. (Withdrawn) The method of claim 26, wherein the mathematical inversion is based on a maximum entropy process.

29. (Withdrawn) The method of claim 26, wherein the multi-dimensional distribution is displayed along a fluid diffusion axis and a T_2 relaxation axis.

30. (Withdrawn) The method of claim 29, wherein the graph includes an overlay with ideal diffusion and T_2 relaxation values.

31. (Withdrawn) The method of claim 29, wherein the formation evaluation values are quantitative values associated with the fluid instance of at least one of fluid volume, saturation, viscosity, porosity and permeability.